

## VENT-MOUNTABLE MOTOR-VEHICLE ANTENNA

## SPECIFICATION

## FIELD OF THE INVENTION

The present invention relates to an antenna. More particularly this invention concerns a high-frequency antenna that can be mounted in a vent of a motor vehicle in particular for use by a mobile radio set or telephone.

## BACKGROUND OF THE INVENTION

US patent 6,686,888 describes a high-frequency antenna for use with a mobile radio that is mounted in the vent grill. The antenna comprises a monopole and ground plane (or balancing antennas) all formed as conductive traces on flat T-shaped printed-circuit board. The board is fitted to the plastic vent grille and acts as a so-called slit antenna, particularly usable in the 2.4 GHz range. The ground plane extends at a right angle to the monopole, and there may be in fact two ground planes.

## OBJECTS OF THE INVENTION

It is an object of the present invention to provide an improved antenna.

Another object is the provision of such an improved  
5 antenna which is of simpler and more durable construction than the prior-art devices.

## SUMMARY OF THE INVENTION

A motor-vehicle antenna has according to the invention a monopole formed by a rigid circuit-board having a conductive  
10 trace, a socket for connecting a coaxial cable to the monopole, and a ground plane formed of rigid sheet metal or a circuit board and fixed to the monopole.

When the ground plane or balancing antenna is formed of sheet metal, the antenna is very rugged and it has fewer parts  
15 than the prior-art such antennas. As a result such an antenna can be made very inexpensively. A sheet-metal ground plane can be made simply by stamping.

When the ground plane or balancing antenna is formed of a printed-circuit board, the resultant structure is still quite  
20 durable and fairly light. The use of a printed-circuit board makes it easy to mount the antenna in a motor vehicle without having to provide insulated supports engaged between the ground plane and the grounded vehicle body, as the connection can be

made to the phenolic board of the printed circuit in a location where it has not conductive traces. A printed-circuit ground plane can be provided with clips or fasteners allowing it to be screwed or riveted in place in, for example, a motor-vehicle vent.

According to a further feature of the invention, the monopole and the ground plane are permanently bonded together, typically by soldering. This produces a very solid mechanical connection that conducts electricity well. Of course, instead of solder it would be possible to use a strong conductive adhesive for the bonding.

The ground plane in accordance with the invention, in particular when of sheet metal, is formed with an edge flange to which the monopole is fixed. This flange is formed with a groove or seat into which the circuit board of the monopole fits for a strong connection. The flange is central so the resultant structure has the standard T-shape of a monopole with a pair of ground planes. Thus the ground plane and monopole are both substantially planar and extend generally perpendicular to each other. Such a structure can easily be integrated into the grill of a motor-vehicle vent so it is safe but virtually invisible.

The socket includes jaws crimpable to the coaxial cable. Hence the cable can be solidly connected to the antenna by a standard cable crimper.

The socket according to the invention is fixed to the monopole or to the ground plane. When the ground plane is made

of sheet metal, the socket can even be unitarily formed with the ground plane. If not unitary, the socket can have tabs set in the monopole or ground plane so the cable connection is very strong.

5           According to a further feature of the invention, a splitter is provided having a pair of sockets connectable via respective coaxial cables to two such monopoles and another socket connectable to a receiver or transmitter, so that this splitter can be used to feed a signal from a transmitter to two  
10   antennas, or can combine the signals from two antennas on opposite sides of the vehicle and feed them to a receiver. Either way the splitter has a housing holding the printed-circuit board of the splitter, and in which the board can actually be potted, along with inner ends of the sockets. Such a splitter  
15   can be mounted anywhere in the vehicle.

## BRIEF DESCRIPTION OF THE DRAWING

The above and other objects, features, and advantages will become more readily apparent from the following description, it being understood that any feature described with reference to one embodiment of the invention can be used where possible with any other embodiment and that reference numerals or letters not specifically mentioned with reference to one figure but identical to those of another refer to structure that is functionally if not structurally identical. In the accompanying drawing:

FIGS. 1 and 2 are perspective views of an antenna according to the invention;

FIGS. 3 and 4 are perspective views of a second antenna in accordance with the invention;

FIG. 5 is a perspective view of a third antenna;

FIG. 6 is a perspective view of a summing connector for the antennas of this invention; and

FIGS. 7 and 8 are perspective views of a further antenna in accordance with the invention.

## SPECIFIC DESCRIPTION

As seen in FIGS. 1 and 2, an antenna 1a according to the invention is basically comprised of a monopole 2a formed as a conductive trace on a nonconductive printed-circuit board and a sheet-metal double ground plane 3a comprised of a strip of sheet metal lying in a plane extending orthogonally to the plane of the monopole 2a and forming therewith a T-shape. The sheet-metal ground planes 1 are formed centrally with a perpendicular edge flange 4a delimited by slots 3a' and having its own central slot 4a' in which the monopole 2a is fitted. A socket sleeve 5a grips a coaxial cable 6 having a central conductor 13 connected by bonding or solder to the monopole trace and set in a groove 2a' of the monopole 2. The sleeve 5a is formed as a pair of claws having teeth 5a' that dig into the insulation of the cable 6 and lock it physically very solidly to the antenna 1a, and a tab 5a" of the sleeve 5a is fitted in a slot 2a' in the monopole 2a. Another bond can be provided at the slot 4a' holding the monopole 2a in place.

FIGS. 3 and 4 show an antenna 1b like the antenna 1a, but with functionally identical parts carrying a postscript "b" instead of "a." Here the printed-circuit monopole 2b is formed with a pair of notches 2b' into which tabs 5b' of the socket 5b are fitted. In addition two other tabs 5b" of the socket 5b engage flatly with the monopole 2b and may electrically connect the braid shielding of the cable 6 to a trace on the back of the

monopole 2b. The ground plane 3b here is formed as a printed-circuit board, like the monopole 2a, and the monopole 2a extends at an acute angle to the ground plane 3b.

The antenna 1c of FIG. 5 is like that of FIGS. 3 and 4, except that the monopole 2c is perpendicular to the printed-circuit ground plane 3c and is set in grooves 3c' thereof. In addition the edge of the monopole 2c is formed with a notch 2c' for the conductor 13 and another notch 2c" for the single tab 5c' of the socket 5c.

FIG. 6 shows a summing point or splitter 7 for connecting two antennas to a single receiver and/or transmitter. It has a printed-circuit board 8 carrying on its unillustrated underside electronic and circuit elements for connecting two input/output sockets 10 with a single output/input socket 11. The board 8 is surrounded by a housing 9 and is normally closed over the sockets 10 and 11 by a cover with a gasket. The board 8 is fixed by snaps or the like to the housing 9 and the conductors and braid shields of cables plugged into the sockets 10 and 11 are connected by soldering or some other conductive bond to the elements and traces of the board 8. This device can be used to feed a signal from a transmitter to two antennas, or to feed the signal from two antennas to a single receiver. The sockets 10 and 11 can in fact be imbedded in the board 8 and can be of different construction, for example male externally threaded. Such a splitter can be mounted out of the way in the vehicle and

does not need to be close to either the transmitter/receiver or the antennas.

FIGS. 7 and 8 show an antenna 12c formed much like the antenna 1a of FIGS. 1 and 2, that is having a printed-circuit monopole 2c set on a sheet-metal double balancing antenna or ground plane 3c having a flange 4c. Here, however, the socket or sleeve 5c for the coax feed line 6 is formed unitarily with the flange 4c. Hence the cable 6 is very solidly mounted to this one-piece part forming the two ground planes 3c and the flange 4c, producing a very rugged assembly.